Computer Science

Faculty Electrical Engineering,
Mathematics and Computer Science,
University of Twente

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CONTENTS

This report was finalized on 20 December 2013

Report on the master's programmes Computer Science, Telematics and Human Media Interaction of University of Twente

This report takes the NVAO's Assessment framework for limited programme assessments as a starting point.

Administrative data regarding the programmes

Master's programme Computer Science

Name of the programme:	Computer Science
CROHO number:	60300
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	Computer Security, Information and Software Engineering, Methods and Tools for Verification, Wiresless and Sensor Networks
Location(s):	Enschede
Mode(s) of study:	full time
Expiration of accreditation:	31-12-2014

Master's programme Telematics

Name of the programme:	Telematics
CROHO number:	60032
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	
Location(s):	Enschede
Mode(s) of study:	full time
Expiration of accreditation:	31-12-2014

Master's programme Human Media Interaction

Name of the programme:	Human Media Interaction
CROHO number:	60030
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	
Location(s):	Enschede
Mode(s) of study:	full time
Expiration of accreditation:	31-12-2014

The visit of the assessment committee Computer Science to the Faculty Electrical Engineering, Mathematics and Computer Science of University of Twente took place on 24 and 25 October 2013.

Administrative data regarding the institution

Name of the institution:	University of Twente
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	applied (pending)

Quantitative data regarding the programmes

The required quantitative data regarding the programmes are included in Appendix 5.

Composition of the assessment committee

The committee that assessed the master's programmesComputer Science, Telematics and Human Media Interaction consisted of:
The committee that assessed the master's programme Computing Science consisted of:

- Prof.dr. J. Paredaens (chairman), retired professor in Database Research, Antwerp University;
- Prof.dr. L. Bijlsma (member), professor Software Construction and Vice-Dean of the Faculty Management, Science and Technology, Open University;
- Prof.dr.ir. B. Preneel (member), professor in Information Security, KU Leuven;
- Prof.dr.ir. W. Van Petegem (member), associate professor and Director Teaching and Learning, KU Leuven;
- P. Boot Bsc (student member), master student Computer Science, Utrecht University.

The committee was supported by drs. A. van Vliet, QANU staff member, who acted as secretary.

The University of Twente board and the Accreditation Organisation of the Netherlands and Flanders (NVAO) agreed to the composition of the assessment committee. Appendix 1 contains the curricula vitae of the members of the committee. All members of the committee and the secretary signed a declaration of independence as required by the NVAO protocol to ensure that they judge without bias, personal preference or personal interest, and the judgement is made without undue influence from the institute, the programme or other stakeholders (see Appendix 8).

Working method of the assessment committee

The assessment of the master's programmes Computer Science, telematics and Human Media interaction was part of an assessment cluster. In total, the committee assessed 26 programmes from ten universities: Delft University of Technology, Open Universiteit, University of Groningen, Eindhoven University of Technology, Utrecht University, University of

Amsterdam/VU University Amsterdam, Radboud University Nijmegen, Leiden University and University of Twente.

The assessment committee Computer Science 2013 consisted of 10 members:

- Prof.dr. J. Paredaens (chair), retired professor in Database Research, Antwerp University;
- Prof.dr. L. Bijlsma (member), professor in Education and Software Construction and Vice-Dean of the Faculty of Management, Science and Technology, Open University;
- Prof.dr.ir. B. Preneel (member), professor in Information Security, KU Leuven;
- Prof.dr. J. van den Herik (member), professor in Computer Science, Tilburg University;
- Prof.dr.ir. K. De Bosschere (member), professor in Computer Science, Ghent University;
- Prof.dr. S. Mauw (member), professor in Security and Trust of Software Systems, University of Luxembourg;
- Prof.dr. S. Mullender (member), Director of the Network Systems Laboratory at Bell Labs, Antwerp and professor Systems Research, University of Twente;
- Prof.dr.ir. W. Van Petegem (member), associate professor and Director Teaching and Learning, KU Leuven;
- P. Boot Bsc (member), student Computer Science, Utrecht University;
- R. Verbij Bsc (member), student Computer Science, University of Twente.

Preparation
The committee held a preliminary meeting on April 26, 2013. During this meeting the committee was instructed about the accreditation framework and the programme of the upcoming assessments. A vice-chair for each visit was appointed and the Domain Specific Framework for Computer Science was set (see Appendix 2).
To prepare the contents of the site visits, the coordinator first checked the quality and completeness of the Critical Reflection Reports prepared by the programmes. After establishing that the Reports met the demands, they were forwarded to the participating committee members. The committee members read the reports and formulated questions on their contents. The coordinator collected the questions and arranged them according to topic.

As well as the Critical Reflection Report, the committee members read a selection of fifteen theses for the master's programme. The theses were randomly and stratified chosen from a list of graduates of the last two completed academic years within a range of grades.

Site visit
A preliminary programme of the site visit was made by the coordinator and adapted after consultation of the committee chairman and the programme coordinator of the University of Twente. The timetable for the visit in Enschede is included as Appendix 6.

Prior to the site visit the committee asked the programmes to select representative interview partners. During the site visit meetings were held with panels representing the faculty management, the programme management, alumni, the programme committee and the Board of Examiners. Meetings were also held with representatives of the students and teaching staff. Well in advance of the visit, the committee approved a list of the selected interview partners.

During the site visit the committee examined material it had requested; an overview of this material is given in Appendix 7. The committee gave students and lecturers the opportunity – outside the set interviews – to speak informally to the committee during a consultation hour. No requests were received for this option.

The committee used the final part of the visit for an internal meeting to discuss the findings. The visit was concluded with a public oral presentation of the preliminary impressions and general observations by the chair of the committee.

Report
Based on the committee's findings, the coordinator prepared a draft report. This report was presented to the committee members involved in the site visit. After receiving approval, the draft report was sent to the faculty with the request to check it for factual inaccuracies. The comments received from the programme were discussed with the committee chairman. The final version of the report was sent to the committee members for a final check. Subsequently the definitive report was approved and sent to the University of Twente.

Decision rules

In accordance with the NVAO's Assessment framework for limited programme assessments (as of 22 November 2011), the committee used the following definitions for the assessment of both the standards and the programme as a whole.

Generic quality
The quality that can reasonably be expected in an international perspective from a higher education bachelor's or master's programme.

Unsatisfactory
The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.

Satisfactory
The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.

Good
The programme systematically surpasses the current generic quality standards across its entire spectrum.

Excellent
The programme systematically well surpasses the current generic quality standards across its entire spectrum and is regarded as an (inter)national example.

Summary judgement

This report reflects the findings and considerations of the committee on the Master's programmes in Computer Science, Telematics and Human Media Interaction of the University of Twente.

The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Master's programme Computer Science:

Standard 1
The Master's programme Computer Science enables its students to design, analyze, validate and implement complex information technology systems. Students specialize in one of the following themes:

- Security of computer systems and protection of privacy
- The engineering of information systems and the development of software systems
- Methods and tools for formal development and verification of systems
- The design and application of wireless and sensor systems

The profile of the master's programme is, according to the committee, clearly presented and recognizable for students. The intended learning outcomes of the programme are in line with the Domain specific Framework of Reference and with the level according to international requirements for academic master's degree programmes.

Standard 2
The general structure of the 120 EC course programme is as follows: Basic and advanced courses (forming the specialization component of the programme), Elective courses (chosen from other specializations), Computer Ethics (a 5 EC course), a 20 EC Traineeship (optional), Research Topics (10 EC), the Final Project (30 EC). Students have a large amount of flexibility in composing their individual study programmes.

The Computer Security specialization is offered in cooperation with partners from TU Eindhoven and RU Nijmegen who, together with University of Twente, have teamed up in the Kerckhoffs Institute. This cooperation is according to the committee very positive. It provides the student with a potentially rich programme in computer security. However, the organisation of this Institute and in particular the technical facilities for web lectures and webinars can be improved.

The committee is of the opinion that the programme enables the students to achieve the intended learning outcomes. The committee established that the programme provides guarantees that students compose a coherent individual study programme and at the same time gives the students ample opportunity to tailor their individual schedules to their needs. The students are adequately trained in academic and research skills. The programme is feasible and the students are well guided.

The committee established that the programme has attention for internationalisation but that the effects for the Dutch students going abroad are limited.

The accessibility of the teachers is appreciated and the quality and quantity of the teaching staff is adequate.

The committee appreciates the active involvement of students and the students association in the programme committee and quality assurance in general. According to the committee the programme committee functions well and there is sufficient attention for the improvement of the programme. Nevertheless the committee recommends to involve the working field and alumni and to make use of their input in developing and innovating the programme.

Standard 3
The committee has established that the Faculty Electrical Engineering, Mathematics and Computer Science has a transparent, reliable and valid assessment system. The Board of Examiners fulfils its legal tasks and is proactively engaged with improving the quality of the assessment procedures and the tests.

The committee studied a selection of master theses and has established that the students achieve the intended learning outcomes of the the master's programme Computer Science.

Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Assessment and achieved learning outcomes	satisfactory
General conclusion	satisfactory

Master's programme Telematics

Standard 1
The Master's programme Telematics enables its students to design, analyze, validate and implement complex telematics systems. This programme is nationally and internationally rather unique in the combination of a wide range of state-of-the-art concepts and paradigms to deal with both technogical, functional, qualitative, and operational aspects of telematics systems. The programme focuses on the following themes:

- Management, measurement and security of networks
- Mobile and ad-hoc networks
- Performance modeling and evaluation.

The profile of the master's programme is, according to the committee, clearly presented and recognizable for students. The intended learning outcomes of the programme are in line with the Domain specific Framework of Reference and with the level according to international requirements for academic master's degree programmes.

Standard 2
The general structure of the 120 EC course programme is as follows: Basic and advanced courses (forming the specialization component of the programme), Elective courses (chosen from other specializations), Computer Ethics (a 5 EC course), a 20 EC Traineeship (optional), Research Topics (10 EC), Final Project (30 EC). Students have a large amount of flexibility in composing their individual study programmes.

The committee is of the opinion that the programme enables the students to achieve the intended learning outcomes. The committee established that the programme provides

guarantees that students compose a coherent individual study programme and at the same time givesthe students ample opportunity to tailor their individual schedules to their needs. The students are adequately trained in academic and research skills. The programme is feasible and the students are well guided.

The committee established that the programme has attention for internationalisation but that the effects for the Dutch students going abroad are limited.

The accessibility of the teachers is appreciated and the quality and quantity of the teaching staff is adequate.

The committee appreciates the active involvement of the students and the students association in the programme committee and quality assurance in general. According to the committee the programme committee functions well and there is sufficient attention for the improvement of the programme. Nevertheless the committee recommends to involve the working field and alumni and to make use of their input in developing and innovating the programme.

Standard 3
The committee has established that the Faculty Electrical Engineering, Mathematics and Computer Science has a transparent, reliable and valid assessment system. The Board of Examiners fulfils its legal tasks and is proactively engaged with improving the quality of the assessment procedures and the tests.

The committee studied a selection of master theses and has established that the students achieve the intended learning outcomes of the master's programme Telematics.

The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Master's programme Telematics:

Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Assessment and achieved learning outcomes	satisfactory
General conclusion	satisfactory

Master's programme Human Media Interaction

Standard 1
Graduates of the Master's Human Media Interaction have thorough knowledge and insight in the field of Human Computer Interaction (HCI). Human Computer Interaction as a research domain focuses on various parts. One part deals with algorithms and technology that make interaction possible (e.g. speech and language processing) while the other is focused on designing human computer interaction with the human user in mind (human factors, user-centered design, ergonomics) or evaluating the interaction (usability, user experience). Both parts are represented in the programme, taking the computational perspective as a starting point.

The profile of the master's programme is, according to the committee, clearly presented and recognizable for students. The intended learning outcomes of the programme are in line with the Domain specific Framework of Reference and with the level according to international requirements for academic master's degree programmes.

Standard 2
The general structure of the 120 EC course programme is as follows: Basic and advanced courses (forming the specialization component of the programme), Elective courses (chosen from other specializations), Computer Ethics (a 5 EC course), a 20 EC Traineeship (optional), Research Topics (10 EC), Final Project (30 EC). Students have a large amount of flexibility in composing their individual study programmes.

The committee is of the opinion that the programme enables the students to achieve the intended learning outcomes. The committee established that the programme provides guarantees that students compose a coherent individual study programme and at the same time givesthe students ample opportunity to tailor their individual schedules to their needs. The students are adequately trained in academic and research skills. The programme is feasible and the students are well guided.

The committee established that the programme has attention for internationalisation but that the effects for the Dutch students going abroad are limited.

The accessibility of the teachers is appreciated and the quality and quantity of the teaching staff is adequate.

The committee appreciates the active involvement of the students and the students association in the programme committee and quality assurance in general. According to the committee the programme committee functions well and there is sufficient attention for the improvement of the programme. Nevertheless the committee recommends to involve the working field and alumni and to make use of their input in developing and innovating the programme.

Standard 3
The committee has established that the Faculty Electrical Engineering, Mathematics and Computer Science has a transparent, reliable and valid assessment system. The Board of Examiners fulfils its legal tasks and is proactively engaged with improving the quality of the assessment procedures and the tests.

The committee studied a selection of master theses and has established that the students achieve the intended learning outcomes of the master's programme Telematics.

The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

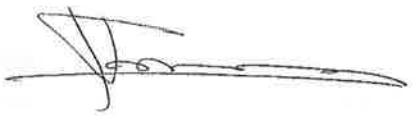
The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Master's programme Human Media Interaction :

Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Assessment and achieved learning outcomes	satisfactory
General conclusion	satisfactory

The chair and the secretary of the committee hereby declare that all members of the committee have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 20 December 2013



prof.dr. J. Paredaens

drs. A. van Vliet

Description of the standards from the Assessment framework for limited programme assessments

Standard 1: Intended learning outcomes

The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements.

Explanation:
As for level and orientation (bachelor's or master's; professional or academic), the intended learning outcomes fit into the Dutch qualifications framework. In addition, they tie in with the international perspective of the requirements currently set by the professional field and the discipline with regard to the contents of the programme.

Findings

This standard deals with the profile and orientation of the master's programmes, the Domain-specific Reference Framework and the intended learning outcomes.

Profile and orientation
The Master's programme *Computer Science* enables its students to design, analyze, validate and implement complex information technology systems. It combines state-of-the-art concepts and paradigms to deal with all aspects of a system. Students specialize in one of the following themes:

- Security of computer systems and protection of privacy
- The engineering of information systems and the development of software systems
- Methods and tools for formal development and verification of systems
- The design and application of wireless and sensor systems

Course programmes are flexible and tailored towards the interest and talents of each individual student. Research and design assignments are performed within the context of on-going research, often in close collaboration with partners from industry. The programme prepares for a specialist job in industry or for a career in research.

The Master's programme *Telematics* enables its students to design, analyze, validate and implement complex telematics systems. This programme is nationally and internationally rather unique in the combination of a wide range of state-of-the-art concepts and paradigms to deal with both technogical, functional, qualitative, and operational aspects of telematics systems. The programme focuses on the following themes:

- Management, measurement and security of networks
- Mobile and ad-hoc networks
- Performance modelling and evaluation

The programme is flexible and tailored towards the interest and talents of each individual student. Research and design assignments are performed within the context of on-going research, often in close collaboration with partners from industry. The programme prepares for a specialist job in industry or for a career in research.

Graduates of the Master's *Human Media Interaction* have thorough knowledge and insight in the field of Human Computer Interaction (HCI). Human Computer Interaction as a research domain has various sides to it. One part deals with algorithms and technology that make interaction possible (e.g. speech and language processing) while the other is focused on designing human computer interaction with the human user in mind (human factors, user-centered design, ergonomics) or evaluating the interaction (usability, user experience). Both parts are represented in the programme, taking the computational perspective as a starting point. The programme trains students both as scientists and engineers. The focus of the programme is on the study and design of intelligent, multimodal interactive systems.

The profiles of the master's programmes are according to the committee clearly presented. The descriptions in the Critical Reflection provide a good picture of the vision behind and the aims of the three programmes. The programmes offer the students a broad choice in different aspects of Computer Science. The profiles of the Master's programmes Computer Science and Human Media Interaction are distinctive, the committee however doubts if the programme Telematics has a future as a distinctive master programme and it did not see any reason why Telematics should not be considered as a specialisation of the Master's programme Computer Science. Although the committee understands the advantage of the visibility of a separate Master's programme it would nevertheless recommend to reconsider the position of the Master's programme Telematics.

Level and orientation
The domain specific framework of reference for the three master's programmes is presented in Appendix 2. This framework is proposed by the National Board of Science Deans ("Landelijk Betadecanenoverleg") in collaboration with the ICAB (Centers for Innovation of Academic Science Education) for Master's degree courses in Computer Science.

In the Critical reflection is indicated how the intended learning outcomes of the four Computer Science specializations, and the intended learning outcomes for Telematics and Human Media Interaction, relate to the Dublin descriptors.

The intended learning outcomes of the programmes are described in Appendix 3 of this report, they refer to both research skills and other academics skills. The general intended learning outcomes, which are valid for all three programmes, clearly describe that graduates should be able to contribute to scientific research. They also contain learning outcomes aimed at more general academic skills, such as team work, and managing and planning developing processes. The committee established that the intended learning outcomes indicate that the programmes train knowledge, understanding, and academic skills founding upon and enhancing the level that is typically associated with the bachelor's level, i.e. the graduate masters specialized knowledge, and is able to apply knowledge and understanding, formulate judgements, and communicate in more complex situations.

The committee has verified that the intended learning outcomes are in line with the domain specific requirements. The learning outcomes indicate sufficiently that the programmes are aiming at a master's degree level.

Considerations

The committee has established that the learning outcomes defined for the Master's programmes Computer Science, Telematics and Human Media Interaction are in line with the

Domain specific Framework of Reference and with the level according to international requirements for academic master's degree programmes.

The profiles of the master's programmes are clearly described and recognizable for the students. The committee recommends however to reconsider the position of the Master's programme Telematics.

Conclusion

Master's programme Computer Science: the committee assesses Standard 1 as **satisfactory**.
Master's programme Telematics: the committee assesses Standard 1 as **satisfactory**.
Master's programme Human Media Interaction : the committee assesses Standard 1 as **satisfactory**.

Standard 2: Teaching-learning environment

The curriculum, staff and programme-specific services and facilities enable the incoming students to achieve the intended learning outcomes.

Explanation:
The contents and structure of the curriculum enable the students admitted to achieve the intended learning outcomes. The quality of the staff and of the programme-specific services and facilities is essential to that end. Curriculum, staff, services and facilities constitute a coherent teaching-learning environment for the students.

Findings

The committee has studied the curricula of the programmes, has seen the course material, the digital learning environment and the results of course evaluations. In this standard the findings of the committee concerning the content and structure of the programme, the intake and the study load, the teaching staff, the facilities and the programme related quality assurance are discussed.

Structure of the programmes
The general structure of the 120 EC course programme, valid for both Computer Science, Telematics, and Human Media Interaction, is as follows:

- Basic and advanced courses (forming the specialization component of the programme);
- Elective courses (chosen from other specializations);
- Computer Ethics (a 5 EC course);
- A 20 EC Traineeship (optional);
- Research Topics (10 EC);
- Final Project (30 EC).

The basic and advanced courses are specific for the specialization component of the programme. The specific courses, the options, and the constraints on the choices, differ for the various programmes. An overview of the courses is presented in Appendix 4.

The Computer Security specialization is offered in cooperation with partners from TU Eindhoven and RU Nijmegen who, together with University of Twente, have teamed up in the Kerckhoffs Institute. This cooperation is according to the committee very positive. It provides the students with a potential rich programme in computer security. However, the organisation of this Institute and in particular the technical facilities for web lectures and webinars can be improved. The committee recommends to include a course on the legal and social dimension in computer security in the obligatory courses for all master's students Computer Science.

Students have a large amount of flexibility in composing their individual study programme. The coherence of the individual study programmes is promoted in two ways. First of all, each individual study programme has to comply to the rules of the relevant specific programme component. This guarantees a coherent choice with respect to the chosen specialization. And secondly, the student has to discuss his or her programme, in order to obtain a formal approval, with the programme mentor of the relevant specialization. This programme mentor has the power to, on behalf of the Board of Examiners, approve individual study programmes of students. The programme mentor has in-depth knowledge of both the course programme and the research in the chair.

The learning activities of the students are a mix of lectures, exercise courses, and practical work and projects. Often the study material consists at least partially of research papers, and students may be required to produce a written report as part of the assessment of a course.

The implicit didactical concept of the programmes is apprenticeship: the student uses and sharpens skills in hands-on experience in close interactions with professionals. Apprenticeship implies that the course programme is flexible and tailored towards individual capacities and preferences, and that students have a large degree of freedom and responsibility in assembling their own personal course plans. It also means that students are very often incorporated in the social activities of a chair, and that the relation teacher-student is transformed into a relation between Master and apprentice. Students, therefore, come in close contact with the research performed in the Department and chairs. Moreover, the courses taught in the Master's programmes are closely related to research at the UT.

All three programmes are taught in English. The intake of foreign students varies between 10-20%. Every year a few students take a foreign internship and one or two students take courses at a foreign university. The committee established that there is attention for internationalization of the programmes, but that the effects are limited.

The committee verified that the development of academic research and writing skills is addressed within the programme. The students are adequately trained in academic and research skills. The committee discussed the programme with the students and teachers and is convinced that the coherence of the Master's programmes is sufficiently monitored and guaranteed by the programme mentors. The Master's programmes give the students ample opportunity to tailor their individual schedules to their needs. The committee studied the overview of courses and got a good impression of the contents of the curricula, which, according to the committee, enable the students to achieve the intended learning outcomes.

Intake and study load
Students with a Bachelor in Computer Science, Business Information Technology or Technical Artificial Intelligence from a Dutch university are automatically admitted to the Master's programmes. All other prospective students have to apply to an Admission Committee (*Toelatingscommissie* or TLC). The TLC is an independent committee, directly appointed by the Dean, consisting of two staff members and the faculty coordinator for international affairs, who acts as secretary.

Students from universities for applied sciences are assigned a pre-Master programme of 10-30 EC, depending on their course record. This pre-Master has to be successfully concluded within a year, in order to obtain admittance to a Master's programme. Foreign students have to fulfill an English language requirement (IELTS 6.5, or TOEFL 90, or Cambridge C1), and are selected on the basis of their course record, grades, and the ranking and reputation of their universities of origin.
Students from the Saxion university of applied sciences have the possibility to take a special preparation minor during their studies. Every year some 10-20 Saxion students make use of this possibility; after which about 5 of them continue in the Master's programme of their choice.

The intake in the Master's Programme Computer Science is on average 45 students, the intake for the programme Telematics is on average 10 and for Human Media Interaction on average 20 students. The average length of study is for all Master's programmes considerably above 24 months. In the discussions with students and teachers it became clear that the long

study duration can partly be blamed to the fact that many students have jobs next to their study and partly to the fact that students take a longer period to do their the final project. The committee established that the programmes are aware of this problem and are taking measures to restrict the time for the final projects. The effects of these actions cannot yet be measured.

For each Master's programme the students can compose their own course programme. The number of contact hours therefore can very from student to student. The students did not mention a high study load. In general the study programme is in their view feasible. 35 % of the students, however, reported having difficulties with the composition of the individual study programme. While the programme did not seem to have taken measures to support the students with this, the committee recommends to have attention for this problem.

The committee concludes that the programmes are feasible and that the study load is adequate. It recommends keep paying attention for the long study duration of the master's students.

Teaching staff
The Department Computer Science responsible for the three Master's Programmes has in total 60 tenured staff members (18.1 fte for teaching). 56 of the 60 teachers have a PhD, 51 have a teaching certificate (*Basis Kwalificatie Onderwijs BKO*). Five teachers recently started with the BKO trajectory. Student- staff ratio is calculated as 25.6 : 1.

The students are contented with the teaching skills of the staff members and the supervision they receive. They report that the staff members are easily accessible and usually react immediately to students' questions.

During the site visit it became clear to the committee that the teaching staff will be cut down with about 20%. This cut down will have a negative impact on the teaching load. It is positive that the programmes are searching for cooperation with other Institutions to ensure the quality of education in the programmes.

The committee concludes that the quantity and quality of the staff is adequate.

Programme specific facilities
Three study advisors take care of all degree programmes in the Faculty Electrical Engineering, Mathematics and Computer Science. During the site visit the studentes reported that the study advisors are easily accessible. All students know where to go with questions and problems.

During the site visit members of the committee had a guided tour and could get an impression of the building and the teaching and research facilities. In general there are enough rooms available for the classes. The facilities are, according to the students and the teachers sufficient. The students only had remarks about the availability of the eduroam network and the speed of the computers.

Information about continuation and study possibilities is available on the web. Besides, the study advisors can be contacted for information and specific introduction events are organised. The students are happy with the availability of the information.

The committee concludes that the programme specific facilities are adequate.

Programme specific quality assurance
One programme committee (OLC-IT) has the task to advise on the quality of the Bachelor programme Applied Computer Science and the Master's programmes Computer Science and Telematics. This committee consists of four staff members and four student members. The OLC has a standard working schedule with issues that are discussed each year. Next to that the OLC reacts to new developments and takes initiatives. The OLC manages evaluations of all courses. Results of these evaluations are discussed with the teachers. The OLC student members indicate which courses need to be investigated. Teachers are present at all evaluation meetings and can immediately give feedback. During the site visit the committee noticed that all students are aware of the existence of the OLC and they all know how to address issues to the OLC. The committee appreciates the involvement of the students in the quality assurance of the courses and their willingness to participate in the OLC.
The OLC Create HMI is concerned with the Master's programme Human Media Interaction. This OLC has the same working method as the OLC IT.

The committee is of the opinion that the programme committees function well. The active contribution and involvement of the students and the students association is positive. The committee establishes that the quality assurance for the programmes is adequate. However, the committee wishes to remark that there is no structural contact with the working field. It recommends to involve the working field and the alumni in the quality assurance procedures of the programmes.

Considerations

The committee is of the opinion that the Master's programmes Computer Science, Telematics and Human Media Interaction enable the students to achieve the intended learning outcomes. The committee established that the programmes provide guarantees that students compose a coherent individual study programme and at the same time givesthe students ample opportunity to tailor their individual schedules to their needs. The students are adequately trained in academic and research skills. The programme is feasible and the students are well guided.

The cooperation between three universities in the Kerkchoffs Institute is according to the committee very positive. It provides the student with a potential rich programme in computer security. The organisation of this Institute and in particular the technical facilities for web lectures and webinars, however, can be improved.

The committee established that the programmes have attention for internationalisation but that the effects for the Dutch students going abroad are limited.

The accessibility of the teachers is appreciated and the quality and quantity of the teaching staff is adequate.

The committee appreciates the active involvement of the students and the students association in the programme committee and quality assurance in general. According to the committee the programme committees function well and there is sufficient attention for the quality assurance. Nevertheless the committee recommends to involve the working field and alumni and to make us of their input in the improvement of the programmes.

Conclusion

Master's programme Computer Science: the committee assesses Standard 2 as **satisfactory**.
Master's programme Telematics: the committee assesses Standard 2 as **satisfactory**.
Master's programme Human Media Interaction : the committee assesses Standard 2 as **satisfactory**.

Standard 3: Assessment and achieved learning outcomes

The programme has an adequate assessment system in place and demonstrates that the intended learning outcomes are achieved.

Explanation:
The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes. The tests and assessments are valid, reliable and transparent to the students.

Findings

This section deals with the assessment system and the level achieved by the graduates of the programmes. These subjects will be described in subsections. In order to establish an opinion about these subjects the committee studied the assessment system and policy of the programmes, the test procedures, test regulations, the used test forms and several tests made by students. The committee also had a meeting and discussion with the Board of Examiners (BoE).

The committee studied a selection of theses for each of the programmes to assess the achieved level of the graduates and had discussions with the students, teachers and alumni about the qualifications of the graduates and the relation to the requirements of the labour market.

Assessment system
The BoE consists of a number of staff members and an external member. The BoE actively caries out its new tasks concerning the quality assurance of assessment. Next to that the BoE handles the formal requests by students. The University of Twente formulated a Framework for the Quality of Testing in reaction to the new law. This framework is translated into a testing policy for the Master's programmes. The members of the BoE furthermore worked on their professionalisation and followed trainings in quality of testing and testing (assessment) policy. The starting point for quality assurance in the Faculty is that teachers play a central role in quality assurance. Monitoring the quality of tests is primarily done by peer review. To make this peer review possible, course dossiers are established. Next to general information about the course, which is also accessible for students, these dossiers contain information about the tests, the results, the grading, the evaluation results and the peer reviews as well as a reflection by the teacher on the results.
The initiative to establish course dossiers is very much appreciated by the committee. It is, however, very recently taken and should be more developed and implemented.

During the meeting of the committee with the BoE it was explained that 'four eyes' is the basic principle of the quality policy. The committee noticed that this policy is not yet completely implemented. The scoring of tests e.g. is not yet done by two examiners. The committee has seen that recently a new assessment form for theses is introduced, which seems to be reliable and transparent. It also established that these new forms are adequately filled out by the examiners.

Achieved learning outcomes
The committee 20 master's theses to assess whether these theses show that the intended learning outcomes are achieved by the graduates. The selection of the theses was randomly and stratified for grades. The committee saw master's theses from all three master's programmes. According to the committee the theses show that the students have achieved

the intended learning outcomes. All master's theses have an adequate academic level. The committee generally agrees with the grading of the theses.

Considerations

The committee has established that the Faculty Electrical Engineering, Mathematics and Computer Science has a transparent, reliable and valid assessment system. The Board of Examiners fulfils its legal tasks and is proactively engaged with improving the quality of the assessment.

The committee has established the students achieve the intended learning outcomes of the the Master's programmes Computer Science, Telematics and Human Media Interaction.

Conclusion

Master's programme Computer Science: the committee assesses Standard 3 as **satisfactory**.
Master's programme Telematics: the committee assesses Standard 3 as **satisfactory**.
Master's programme Human Media Interaction : the committee assesses Standard 3 as **satisfactory**.

General conclusion

The committee noted both positive aspects and some aspects which could be improved in the three Master's programmes. Taking those aspects into consideration, the committee concluded that the Master's programmes Computer Science, Telematics and Human Media Interaction of the University of Twente fulfil the requirements of the criteria set by NVAO which are the conditions for accreditation.

Conclusion

The committee assesses the *master's programme Computer Science* as **satisfactory**.
The committee assesses the *master's programme Telematics* as **satisfactory**.
The committee assesses the *master's programme Human Media Interaction* as **satisfactory**.

Appendices

Appendix 1: Curricula vitae of the members of the assessment committee

Prof. em. J. (Jan) Paredaens was a professor at the University of Antwerp and is now dean of the Faculty of Design Sciences at the same university. He graduated as a mathematician from the Free University of Brussels and was awarded his doctorate in 1974 from the Free University of Brussels. He worked until 1979 in the research centre of the company MBLE in Brussels. In 1979 he was appointed lecturer in Informatics at the University of Antwerp. He filled various positions, including Dean of the Sciences Faculty. He has already been a member of the Informatics review committee in the Netherlands. His scientific specialization is 'Databases and Data mining', on which he has published over 100 international scientific articles. He has also organised a number of international conferences in his subject and is a member of the 'Executive Committee of PODS' in the USA. He was member/chair of numerous Belgian and international committees and panels.

Prof. W. (Wim) Van Petegem is a university professor at the KU Leuven and is also Director of Teaching and Learning. He completed his degree as a civil engineer at the University of Ghent and was awarded his doctorate in 1993 from the KU Leuven. He has worked at the University of Alberta, Edmonton (Canada), the Open University (The Netherlands), Groep T and the KHLeuven (Belgium). He teaches courses on multimedia production and the development of teaching materials (multimedia). His research interests encompass multimedia production, new teaching technology, networked e-learning, virtual mobility, lifelong learning, open and distance education, knowledge transfer and scientific communication. In his specialist field he is involved in numerous international research, development and implementation projects as investigator, coordinator, partner or expert, and he is on the board of various international networks. Given his expertise he has already been a committee member for review committees, in Flanders, the Netherlands and further afield.

Prof. dr. Lex Bijlsma (1949) is professor Education and Softwareconstruction and vice-dean of the Faculty Management, Science and Technology, Open University. He graduated in mathematics in 1973 at the University of Amsterdam and did a PhD on theory of numbers at the same university in 1978. Thanks to a ZW grant he could do research at the *Institut des Hautes Etudes Scientifiques in Bures-sur-Yvette* in 1978-79. In 1979 he became assistant professor at the Eindhoven University of Technology and specialised in computer science. In 1999 Bijlsma was appointed associate professor at Utrecht University, in 2000 director of education computer science and in 2011 also director of education in informatics. In 2007 he was appointed full professor at the Open University. His interest concerns programming methodology, mathematical methods in computer science and software-architecture.

Prof.dr. ir. Bart Preneel is professor at the Department Electrical Engineering-ESAT of the KU Leuven. He received his PhD in 1993 at the KU Leuven in the area of cryptology. He is head of the research group COSIC that foscuses on cryptology, information security and privacy. He was research fellow at UC Berkeley, guest lecturer at 5 universities and academic advisor of Philips. He is president of the IACR (International Association for Cryptologic Research) and member of the Permanent Stakeholders group of ENISA (European Network and Information Security Agency). He participated in several scientific committees, among which: ERC, EPSRC, FNRS, NSF, NWO and STWW.

Peter Boot is master student "Game and Media Technology" at Utrecht University. He did his bachelor's in Computer Science at the same university. He participated in several committees within the university. He was member of the board of the study association A-

Eskwadraat in 2011-2012, student member of the Faculty Council of the Science Faculty in 2012-2013 and board member of the Bètadag Foundation.

Appendix 2: Domain-specific framework of reference

Domain-specific frame of reference for Master's courses in Computer Science

1. Learning outcomes in general

The Dublin descriptors indicate in general terms what levels a student should reach in knowledge and understanding, the application of knowledge and understanding, forming judgments, communication and learning skills to award him the master's title. In the objectives and content of a Master's degree module it must be clear that teaching and assessment of students aims at reaching the goals set in the Dublin descriptors. They are as follows.

Students to whom a Master's degree is awarded:

- Have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with Bachelor's level, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research[1] context;
- Can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;
- Have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements;
- Can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;
- Have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

Domain specific contents, the nature of Master degree modules

The Master's degree module will build upon knowledge and understanding at undergraduate level. The core of this knowledge and understanding is as described by the Joint Task Force for Computing Science Curricula of ACM/IEEE-CS in their (draft) report "Computing Science Curricula 2013" (http://cs2013.org). The contents of the Master's degree programme should lead the student towards the frontiers of design and applications in the field, and/or towards the major research issues in the field.

The students in the Master's degree module will generally concentrate on subjects in a limited specialisation within the field, or in the border region with adjacent fields. If the module borders on adjacent fields (Management Sciences, Electrical Engineering and Telecommunication, Cognitive Science, …) it will meet international standards which are not necessarily only the standards set for Computing Science Curricula. In particular such modules have identified a (international) community of modules of a similar nature and they will fit the standards of that community.

The Master's degree module may not aim at educating students to be researchers, or it may have tracks for students who do not aim at such a goal. There is however always a strong

[1] research' is used to cover a wide variety of activities, with the context often related to a field of study; the term is used here to represent a careful study or investigation based on a systematic understanding and critical awareness of knowledge.

relationship between the degree module and research activities, and researchers are active as lecturers and supervisors in the degree module.
Even if a student who is awarded the degree is not trained to be a researcher, he will have a basic understanding of the nature of research, and he will have proven research skills. In each degree module there will be a final project that takes at least one quarter of the entire module. In the final project the student can show his capabilities in each of the five fields of the Dublin descriptors (knowledge and understanding, application of knowledge and understanding, forming judgments, communication and learning skills).

Preparation for a further career in a PhD position or as a highly qualified professional in the field

A talented and successful student in the Master degree module must be educated to a level where he is eligible for a PhD-position. Participation in research projects, especially during the final project must be open to such students.
The Master's degree module must address the development of skills and competencies that are essential for a working professional. It must be possible for students to participate in cooperation with trade and industry, in particular during a final project. This requires the modules to have sufficient contacts within trade and industry.

Appendix 3: Intended learning outcomes

The Master's programmes have the following general attainment targets:

a. Graduates have an extensive knowledge of and understand the issues relevant to their specific field of study (i.e. domain specific attainment targets) described in Appendices 1F, 1G, or 1H.
b. Graduates can contribute to scientific research, and independently design, conduct and present the results of small-scale research.
c. Graduates can provide an original contribution to the development and/or application of the field of study. 'Original' is understood to mean 'demonstrative of a creative contribution'.
d. Graduates can analyse complex problems (change problems) relevant to the field of study and obtain the required knowledge and information.
e. Graduates can design, validate and implement solutions/systems in their operational context; identify and apply relevant advanced knowledge, methods and techniques from their field of study.
f. Graduates can assess solutions/systems and their applications according to their properties and potential to solve problems even if they are new to or unfamiliar with the situation or lack information and/or reliable information; they can use their assessment as a basis for (substantiation of) decisions.
g. Graduates understand the ethical, social, cultural and public aspects of problems and solutions in their field of study; apply this insight in their international role as scholar.
h. Graduates can work as part of and play a leading role in a team; manage and plan a development process; document development and research processes.
i. Graduates can substantiate research results, designs and applications in writing and verbally; critically assess and participate in debates regarding the same.
j. Graduates can independently acquire new knowledge and skills; reflect on trends in their field of study, responsibilities and roles and use this insight as a guide for and integrate it into their own personal development.
k. Graduates can integrate information from other disciplines into their own work if necessary.
l. Graduates take a critical approach to reading, incorporating information presented in and participating in debates regarding international scientific literature relevant to their field of study.

Specific attainment targets for Computer Science:

The specific attainment targets for the specialization *Computer Security*:

SEC1. graduates have a profound understanding of security and privacy risks in ICT systems and are able to model and evaluate these risks.
SEC2. graduates have a profound understanding and are capable of applying the formal methods and cryptographic foundations underlying security and privacy.
SEC3. graduates have a profound understanding of and gained experience with methodologies for design of secure and privacy-preserving ICT systems.
SEC4. graduates have gained insight into cross-disciplinary aspects of security and privacy such as law and business processes and are able to read and understand texts from those domains or communicate with domain experts from those domains over security and privacy issues.

SEC5. graduates have profound knowledge about and gained first practical experience in methods and approaches for practical security evaluation of ICT systems such as penetration testing or risk management.
SEC6. graduates have specialist knowledge and understanding of one or more sub-fields or aspects of the security and privacy discipline, e.g. Cybercrime or security in mobile systems.
SEC7. graduates have practical experience conducting scientific research into security and privacy methods, contribute to such research, apply the results, follow the trends of this sub-field and contribute to its further development.

The specific attainment targets for the specialization *Information and Software Engineering*:

ISE1. graduates have thorough knowledge of a distributed information system's life cycle (requirement analysis, architecture design, realization and maintenance).
ISE2. graduates have thorough knowledge of workflow, groupware and e-business processes and the distribution of these across organizational units and physical locations.
ISE3. graduates have thorough knowledge of the management of large volumes of internal information, including structured and sensor data, multimedia data or geographic information.
ISE4. graduates are able to combine and configure basic software components of information systems, such as database management systems, transaction processing monitors, workflow management systems and middleware.

The specific attainment targets for the specialization *Methods and Tools for Verification*:

MTV1. graduates have a thorough knowledge of and understand the scope of formal methods as a scientific and design discipline.
MTV2. graduates have a thorough knowledge of, understand and gain practical experience with the application of formal methods and tools in the development process of software, distributed and/or embedded systems.
MTV3. graduates can apply formal methods and tools during system development on the basis of knowledge and insight, make an informed selection of these and contribute to their further development.
MTV4. graduates have knowledge of and understand various aspects of theoretical computer science, including process algebra, proof systems and formal testing theory.
MTV5. graduates have specialist knowledge and understanding of one or more sub-fields or aspects of the formal methods discipline, e.g. Process Algebra, Software Model Checking, Distributed Model Checking, Program Verification, Proof Systems, Testing, Quantitative Modeling and/or Analysis, Graph Transformations, Game Theory.
MTV6. graduates have practical experience conducting scientific research into formal methods, contribute to such research, apply the results, follow the trends of this sub-field and contribute to its further development.

The specific attainment targets for the specialization *Wireless and Sensor Networks*:

WISEa. graduates have knowledge and understanding of flexible and efficient communication.
WISEb. graduates have knowledge and understanding of distributed wireless systems.
WISEc. graduates have knowledge and understanding of distributed data processing and reasoning.

WISE1. graduates have the ability to demonstrate their comprehensive knowledge on principles of wireless and sensor systems.
WISE2. graduates have the ability to understand, analyze, and reason about system-wide aspects and interaction between the key principles of wireless and sensor systems.
WISE3. graduates have the ability to conduct scientific research in wireless and sensor systems and contributing to research in the field.
WISE4. graduates have the ability to apply their knowledge in system-wide context.

Specific attainment targets for Telematics

The specific attainment targets for the Master's programme Telematics:

M-TEL1. graduates have thorough knowledge about and understanding of both wired and wireless communication devices, networks and systems, in terms of both key principles and contemporary technologies.
M-TEL2. graduates can design and evaluate wired and wireless communication devices, networks and systems; in doing so, they can take into account both detailed aspects of the individual components, and system-wide aspects such as security and management.
M-TEL3. graduates can quantitatively evaluate the performance of networked systems, and judge their formal correctness, using both analytical methods and computer tools.
M-TEL4. graduates have practical experience conducting research and/or doing design work in a sub-field of networked systems, can follow trends in the field and contribute to its further development.

Specific attainment targets for Human Media Interaction

HMI1. graduates have a thorough knowledge and understanding of each of the sub-fields listed below and identify and utilize any links:
- methodology of user-oriented design, including the drafting of user requirements, user studies and usability engineering;
- forms of natural interaction, including natural language and speech recognition technology, multimodal interaction and interaction via dialogue systems and conversational agents;
- intelligent interaction employing techniques taken from artificial intelligence, e.g. intelligent multi-agent systems and learning systems;
- media technologies, e.g. image processing, computer vision, graphics and virtual reality, enabling complex interaction.

HMI2. graduates can design, both independently and as part of a team, sophisticated applications involving digital media and interactive systems and geared to the needs of users.
HMI3. graduates can use state-of-the-art techniques, methods and design and development tools in developing sophisticated applications and make an informed selection of and contribute to the further development of these methods, techniques and tools.
HMI4. graduates have knowledge of and gain practical experience with interaction design methods.
HMI5. graduates have knowledge of and understand various aspects of the user context of digital media and interactive systems and, based on this, communicate effectively and efficiently with users during the various phases of the development process.

HMI6. graduates have knowledge of and understand basic questions and research methods into human behavior (psychology and philosophy) and grasp the relevance of these fields of study to the design of interactive systems.
HMI7. graduates can draft, transfer, document and communicate to technical designers specifications on the basis of a knowledge and understanding of the technical aspects of digital media and interactive systems.
HMI8. graduates can assess systems for human media interaction according to their technical and operational aspects, incorporating a thorough knowledge and understanding of mathematics.

HMI graduates have specialist knowledge of one or more of the four Human Media Interaction sub-fields outlined above and practical experience conducting, reporting about and applying the results of scientific research in developing innovative interactive systems and the relevant techniques and methods.

Appendix 4: Overview of the curricula

Specific programme component CSc specialization: Computer Security

Basic courses:		Contributes to attainment target:
192194100	Cryptography 1 (TU/e) (6 EC)	SEC1, SEC2, SEC7
192195200	Security in organizations (RU) (6 EC)	SEC1, SEC3, SEC4, SEC7
192195100	Software security (RU) (6 EC)	SEC1, SEC3, SEC7
192194200	Verification of security protocols (TU/e) (6 EC)	SEC1, SEC2, SEC3, SEC7
201100220	Security and Privacy in Mobile Systems (UT) (6 EC)	SEC1, SEC3, SEC5, SEC6,
201000086	Network security for Kerckhoffs students (UT) (6 EC)	SEC1, SEC3, SEC5, SEC7

Advanced courses (at least three of the following courses)		
191210901	Introduction to Biometrics (UT) (6EC)	SEC1, SEC6, SEC7
192110941	Secure data management (UT) (6 EC)	SEC1, SEC3, SEC7
192195400	Seminar (Privacy) (RU) (6 EC)	SEC1, SEC3, SEC4, SEC7
192194110	Cryptography 2 (TU/e) (6 EC)	SEC1, SEC2, SEC7
192195300	Hardware and operating systems security (RU) (6 EC)	SEC1, SEC3, SEC5, SEC7
192195500	Law in cyberspace (RU) (6 EC)	SEC1, SEC4, SEC7
201100140	Hacker's Hut (TU/e) (6 EC)	SEC1, SEC5, SEC7
192194400	Seminar information security technology (TU/e) (6 EC)	SEC1, SEC7
201100221	Cyber-crime Science (UT) (6 EC)	SEC1, SEC4, SEC6, SEC7

Specific programme component CSc specialization: Information and Software Engineering

Basic courses:		Contributes to attainment target:
192110902	Advanced Database systems	ISE1, ISE3, ISE4
192320820	Design science methodology	ISE1, ISE4

Basic courses (at least three of the following courses):		
192320111	Architecture of information systems	ISE1, ISE2
192340041	Software Management	ISE4, (SE)
201200044	Managing Big Data	ISE3
192110940	Secure Data management	ISE1
192110961	XML & Databases 1	ISE3, ISE4
192320501	Electronic Commerce	ISE1, ISE2
192320850	Advanced requirements engineering (start module)	ISE1, ISE2
192330301	Specification of information systems	ISE1,ISE3
192652150	Service-oriented architecture with web services	ISE1, ISE2
192111332	Design of Software Architectures	(SE)

Advanced courses (at least four of the following courses):		
201300074	Research Experiments with Data and Information retrieval	ISE3, ISE4
192160400	Information retrieval	ISE3
192320220	Advanced architecture of information systems	ISE1, ISE2
192320850	Advanced requirements engineering (follow up modules)	ISE1, ISE2
192135450	Advanced Design of Software Architectures - Model Driven Engineering	(SE)
192135400	Advanced Design of Software Architectures – Product Line Engineering	(SE)

Specific programme component specialization: Methods and Tools for Verification

Basic courses:		Contributes to attainment target:
192111092	Advanced Logic	MTV3, MTV4, MTV6
192135310	Modelling and Analysis of Concurrent Systems 1	MTV1, MTV2, MTV3, MTV4, MTV5
192140122	System Validation	MTV1, MTV2, MTV3
192170015	Testing Techniques	MTV1, MTV2, MTV5
192135320	Modelling and Analysis of Concurrent Systems 2	MTV1, MTV4, MTV5, MTV6
192114300	Program Verification	MTV1, MTV4, MTV5, MTV6

Advanced courses (at least three of the following courses):		
192111332	Design of Software Architectures	(SE)
192130092	Fault Tolerant Digital Systems	MTV2
191520751	Graph Theory	MTV4
191560561	Introduction to Mathematical Systems Theory	MTV5
201200006	Quantitative Evaluation of Embedded Systems	MTV3, MTV5
192620300	Performance Evaluation	MTV5
191210341	Physical Systems Modelling of Embedded Systems	MTV2
191580251	Mathematical Programming	MTV4
192135450	Advanced Design of Software Architectures - Model Driven Engineering	MTV3
192135400	Advanced Design of Software Architectures - Product Line Engineering	(SE)

Advanced courses (at least two the following courses):		
192114100	Principles of Model Checking	MTV1, MTV4, MTV5, MTV6
201300042	Limits to Computing	MTV4
191581420	Optimization Modelling	MTV4

Specific programme component CSc specialization: Wireless and Sensor Networks

Basic courses:		Contributes to attainment target:
192620010	Mobile and Wireless Networking I	Wa, W1, W2
201000075	Wireless Sensor Networks	Wa, Wb, Wc, W1, W2, W3, W4
191211590	System-on-Chip for ES	Wa, W1, W4
192111301	Ubiquitous Computing	Wb, Wc, W1, W3, W4

Advanced courses (at least four of the following courses):		
192130112	Distributed Systems	Wb, W1, W2, W4
191211030	Mobile Radio Communications	Wa, W1, W2
192620300	Performance Evaluation	Wb, W1, W2, W4
192620020	Mobile and Wireless Networking II	Wa, Wb, W1, W2, W4
191210590	Embedded Signal Processing	Wa, W1, W2
191211650	Multi Disciplinary Design Project	Wc, W1

Specific programme component Telematics

Basic courses:		Contributes to attainment target
192620010	Mobile and wireless networking 1	TEL1
192620300	Performance evaluation	TEL3
192652150	Service oriented architecture with web services	TEL1, TEL2
192654000	Network security	TEL2

Advanced courses (at least six of the following courses):

(at least one of the following courses on modeling and validation):		
201200006	Quantitative Evaluation of Embedded Systems	TEL3
192140122	System validation	TEL3
192170015	Testing techniques	TEL3
(at least two of the following courses on networking technologies):		
191211710	Core networks	TEL1, TEL2
192620020	Mobile and wireless networking 2	TEL1, TEL2
192620250	Selected topics in P2P systems	TEL1, TEL2
192653100	Internet management and measurement	TEL1, TEL2
(zero or more of the following courses):		
191210780	Modern Communication Systems	TEL4
191210800	Information Theory	TEL4
191211030	Mobile radio communications	TEL4
192111301	Ubiquitous computing	TEL4
192135450	Advanced Design of Software Architectures – Model Driven Engineering	TEL4
192140700	The numbers tell the tale (meten = weten)	TEL4
201100140	Hacker's Hut (offered by TU/e)	TEL4
192195200	Security in organizations (offered by RU)	TEL4
192320111	Architecture of information services	TEL4
192631000	Mobile e-health applications and services	TEL4

Specific programme component Human Media Interaction

(At least 40 EC in basic and advanced courses together; at least 10 and at most 15 EC in basic and advanced courses supporting HMI 5, at least 5 EC in support of HMI 1b and also HMI 1c)

Basic courses:		Contributes to attainment target:
191612680	Computer Ethics (mandatory);	HMI 5
192166100	HMI project (mandatory);	HMI 1a, HMI 2, HMI 3, HMI 4, HMI 7
192165201	KMT Mediatechnologie	HMI 2, HMI 5
201200123	Intelligent Systems	HMI 5
192166310	Speech and language processing 1,	HMI 1b, HMI 2

Advanced courses :

201000113	User Centred Design of New Media	HMI 2, HMI 5, HMI 6
192166320	Speech and language processing 2	HMI 1b, HMI 2
192166370	Conversational agents	HMI 1b, HMI 6
201000078	Brain Computer Interfacing	HMI 1b, HMI 7
192320601	Multi agent systems	HMI 1c, HMI 8
192166420	Machine learning	HMI 1c, HMI 3, HMI 7, HMI 8
201200063	Philosophy of technology	HMI 5, HMI 6
192165201	KMT Mediatechnologie	HMI 5, HMI 6
201100126	Human Computer Interaction	HMI 1a, HMI 4, HMI 5

192934090	Human Error	HMI 5, HMI 6
191210910	Image processing and computer vision	HMI 1d, HMI 3, HMI 8
192160400	Information retrieval	HMI 1d

Appendix 5: Quantitative data regarding the programmes

Data on intake, transfers and graduates

Intake Computer Science

	Year:	2007	2008	2009	2010	2011
Provenance:						
Own University		46	23	27	23	35
Other Dutch University		-	1	3	1	-
University of Applied Sciences		14	6	9	8	5
Foreign University		1	8	6	3	8
Total		61	38	45	35	48
% female		10%	3%	13%	9%	4%

Intake Telematics

	Year:	2007	2008	2009	2010	2011
Provenance:						
Own University		17	6	4	3	8
Other Dutch University		-	-	-	-	-
University of Applied Sciences		-	-	1	-	-
Foreign University		3	1	-	4	4
Total		20	7	5	7	12
% female		5%	0%	0%	0%	0%

Intake Human Media Interaction

	Year:	2007	2008	2009	2010	2011
Provenance:						
Own University		31	13	10	8	13
Other Dutch University		-	1	1	-	1
University of Applied Sciences		6	1	6	2	3
Foreign University		-	-	1	4	2
Total		37	15	18	14	19
% female		8%	13%	6%	14%	32%

Intake Three Masters (CSc, M-TEL, HMI) combined

	Year:	2007	2008	2009	2010	2011
Provenance:						
Total intake		118	60	68	56	79
University of Applied Sciences		20	7	16	10	8
Percentage:		17%	12%	24%	18%	10%
Foreign University		4	9	7	11	14
Percentage:		3%	15%	10%	20%	18%

Number of graduates Computer Science

	Year:	2007	2008	2009	2010	2011
Provenance:						
Own University		34	31	31	27	15
Other Dutch University		2	-	1	-	1

University of Applied Sciences		2	2	3	3	6
Foreign University		1	1	4	2	4
Total		39	34	39	32	26

Average length of study (in months) of graduates Computer Science

	Year:	2007	2008	2009	2010	2011
Provenance:						
Own University		24	32	34	34	34
Other Dutch University		41	-	15	-	27
University of Applied Sciences		33	35	45	38	47
Foreign University		27	22	24	30	29

Number of graduates Telematics

	Year:	2007	2008	2009	2010	2011
Provenance:						
Own University		10	14	4	6	5
Other Dutch University		-	-	-	-	-
University of Applied Sciences		-	-	-	-	-
Foreign University		-	4	1	1	1
Total		10	18	5	7	6

Average length of study (in months) of graduates Telematics

	Year:	2007	2008	2009	2010	2011
Provenance:						
Own University		16	25	21	28	49
Other Dutch University		-	-	-	-	-
University of Applied Sciences		-	-	-	-	-
Foreign University		-	30	73	36	24

Number of graduates Human Media Interaction

	Year:	2007	2008	2009	2010	2011
Provenance:						
Own University		29	13	17	9	13
Other Dutch University		1	-	-	-	1
University of Applied Sciences		-	-	1	3	3
Foreign University		-	-	-	-	2
Total		30	13	18	12	19

Average length of study (in months) of graduates Human Media Interaction

	Year:	2007	2008	2009	2010	2011
Provenance:						
Own University		25	29	39	41	46
Other Dutch University		29	-	-	-	25
University of Applied Sciences		-	-	28	51	45
Foreign University		-	-	-	-	24

Teacher-student ratio achieved

	Number	fte
Professor	12	4.2
Part time Professor	11	1.2
Associate Professor	12	3.9
Assistant Professor	25	8.8
Total	60	18.1

All staff members have a master's degree. 56 of the 60 teachers (18.1 fte) have a PhD (93%).

Student-staff ratio is 25.6 : 1

Average amount of face-to-face instruction per stage of the study programme

Activity	Year 1	Year 2
Lectures	192	64
Exercise courses	192	64
Tests and examinations	36	12
Project/ Practical work	284	92
Supervising during Thesis	-	60
Total	**704**	**292**
Self Study	976	1388
Total	**1680**	**1680**

So the average amount of contact hours per week in the first year is 704/42 = 16.8 hours per week, and in the second year 292/42 = 7.0 hours per week. The overall average number of contact hours is 996/84 = 12 contact hours per week.

Appendix 6: Programme of the site visit

Bezoekprogramma visitatiecommissie Informatica Universiteit Twente 24-25 oktober 2013

Dag 1:		
12.00	13.00	Aankomst en lunch commissie
13.00	15.00	Voorbereidend overleg van de commissie + inzage documenten
15.00	16.00	Management: Dr. G.F. (Gerrit) van der Hoeven, Opleidingsdirecteur HMI (panelleider) Dr.ir. R. (Rom) Langerak, Opleidingsdirecteur TI, CSc, TEL Drs. J. (Jan) Schut, Mastercoördinator, coördinator Internationalisering Drs. J.H. (Hans) Romkema, coördinator Kwaliteitszorg Dr. A.K.I. (Anne) Remke, coördinator Leerlijnen
16.00	16.45	Studenten bachelor: T. (Twan) Coenraad (panelleider) R. (Rob) Stortelder S. (Sebastiaan) La Fleur W.J.B. (Wietze) Beukema J.J. (Jip) Spel I.R. (Iris) Heerlien
16.45	17.30	Studenten master: D.P. (Daniel) Davison (HMI) R.M. (Ronald) Meijer (CSc) J.M. (Jarmo) van Lenthe (CSc) W.B.T. (Wietse) Smid (CSc) R. (Rolf) Biesbroek (TEL) B.J. (Bernd) Meijerink (TEL) F.M.A. (Floris) Erich (CSc)
17.30	18.00	Alumni: J. (Johan) Noltes MSc B. (Brend) Wanders MSc W. (Ward) van Wanrooij MSc Ir. H. (Hans) Schaap I. (Irma) Veldman MSc M. (Mattijs) Ugen MSc E.F. (Evert) Duipmans MSc
18.00	18.30	Internoverleg commissie
19.30		Diner (alleen commissie)
Dag 2:		
8.30	9.00	OLC-IT (studenten en docenten) Bachelor IT + master HMI + TEL Prof.dr. P.J.M. (Paul) Havinga (docent, panelleider) Dr. M. (Marieke) Huisman (docent) S. (Stijn) van Winsen (student) B. (Bas) Janssen (student) M.J. (Matthijs) van de Zande (student)
9.00	10.00	Docenten: Prof.dr. D.K.J. (Dirk) Heylen (panelleider) Prof.dr. J.C. (Jaco) van de Pol Dr.ir. A. (Aiko) Pras Ir. E. (Bert) Molenkamp

		Dr.ir. M. (Maurice) van Keulen Dr. M.I.A. (Mariëlle) Stoelinga
10.00	10.30	OLC-HMI: Dr. M. (Mannes) Poel (docent, panelleider) Dr.ir. C. (Cora) Salm (docent) J. (Jan) Kolkmeier (student) D.A.F. (Douwe Bart) Mulder (student)
10.30	11.15	Examencie en studieadviseur: Prof.dr.ir. A. (Arend) Rensink (panelleider) Dr. M. (Mariët) Theune Dr.ir. P.T. (Pieter-Tjerk) de Boer Dr.ir. A.B.J. (André) Kokkeler S.B.A.M. (Sharon) Vonk MSc (studieadviseur) L. (Lilian) Spijker (studieadviseur)
11.15	11.45	Open spreekuur
11.45	13.00	Lunch en voorbereiden eindgesprek
13.00	13.45	Eindgesprek met management Dr. G.F. (Gerrit) van der Hoeven, Opleidingsdirecteur HMI (panelleider) Dr.ir. R. (Rom) Langerak, Opleidingsdirecteur TI, CSc, TEL Prof.dr.ir. A.J. (Ton) Mouthaan (decaan EWI) Drs. J. (Jan) Schut, Mastercoördinator, coördinator Internationalisering Drs. J.H. (Hans) Romkema, coördinator Kwaliteitszorg Dr. A.K.I. (Anne) Remke, coördinator Leerlijnen
13.45	15.30	Opstellen bevindingen
15.30	16.00	Mondelinge rapportage

Appendix 7: Theses and documents studied by the committee

Prior to the site visit, the committee studied the theses of the students with the following student numbers:

0147060	1019562	0067202
0025941	0113409	0166006
1017349	0143316	1103466
0116416	0178578	0045217
0172308	1054783	0093807
0010502	0024570	0037095
166049	0173649	0021377
0067954	1056050	0162000
0027111		

During the site visit, the committee studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

- All material of a selection of courses
- Tests, assessment criteria, assessment forms and answers
- Minutes of the Board of Examiners 2011
- Minutes of het Educational committee 2009 – 2011
- Course evaluations

Appendix 8: Declarations of independence

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nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM:
Dhr. Jan Paredaens

PRIVÉ ADRES:
K Karellaan 42
B-1982 ELEWIJT

IS ALS DESKUNDIGE (voorzitter) / ~~SECRETARIS~~ GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Informatica

AANGEVRAAGD DOOR DE INSTELLING:

TU Delft; Open Universiteit; Rijksuniversiteit Groningen; TU Eindhoven; Universiteit Utrecht, Radboud Universiteit, Universiteit Leiden; UvA/VU; Universiteit Twente

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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nederlands-vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

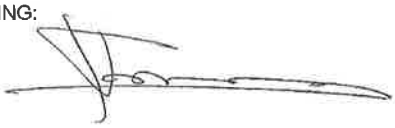
VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Antwerpen

DATUM: 26.4.13

HANDTEKENING:



Q435

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nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: A. Bijlsma

PRIVÉ ADRES:

Maasvalderweg 22, 6229 XT Maastricht

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

B Technische Informatica M Computer Science
M Human Media Interaction M Telematics

AANGEVRAAGD DOOR DE INSTELLING:

U Twente

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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nederlands - vlaamse accreditatieorganisatie

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VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Heerlen DATUM: 9-4-'13

HANDTEKENING:

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: WIM VAN PETEGEM

PRIVÉ ADRES: FAZANTENLAAN 1
B - 3010 KESSEL-LO
BELGIE

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

INFORMATICA

AANGEVRAAGD DOOR DE INSTELLING:

TU Delft, RUG, TU/e, Radboud en UTwente

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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nederlands - vlaamse accreditatieorganisatie

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VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: LEUVEN DATUM: 29/3/2013

HANDTEKENING: 

nvao

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: BART PRENEEL

PRIVÉ ADRES: PROVINCIE STADIONLAAN 54

B-3001 LEUVEN

BELGIË

IS ALS DESKUNDIGE / ~~SECRETARIS~~ GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

INFORMATICA

AANGEVRAAGD DOOR DE INSTELLING:

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN:

nvao

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Leuven

DATUM: 25 juni 2013

HANDTEKENING:

nvao
nederlands - vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM:
Dhr. Peter Boot

PRIVÉ ADRES:

Waranda 82
3705 ZG Zeist

IS ALS DESKUNDIGE / ~~SECRETARIS~~ GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Informatica

AANGEVRAAGD DOOR DE INSTELLING:

Rijksuniversiteit Groningen ; TU Eindhoven; Radboud Universiteit ;
Universiteit Leiden; Universiteit Twente

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

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VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS:
Antwerpen

DATUM:
26-4-2013

HANDTEKENING:

nvao
nederlands-vlaamse accreditatieorganisatie

ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Astrid van Vliet

PRIVÉ ADRES: QANU
Postbus 8055
3503 RA Utrecht

IS ALS ~~DESKUNDIGE~~ / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Informatica

AANGEVRAAGD DOOR DE INSTELLING:

UT

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN:

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nvao
nederlands-vlaamse accreditatieorganisatie

VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

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VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Utrecht DATUM: 11/7/2013

HANDTEKENING: